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ABSTRACT

The Program for Access to Science Study (PASS) consists of a preparatory science course which is taught in tandem with a special counseling seminar. Problem solving is taught using content in chemistry and physics. The curriculum is divided into cycles, each built around a single topic. A problem set related to the topic and an illustrative lab experiment are introduced. The students perform the experiment, analyze the data obtained, work on a problem set based on the experiment, and take a quiz. The seminar is designed to promote students' ability to monitor, evaluate and adjust their behavior in order to achieve their academic and personal goals, and to address issues relevant to achieving academic and personal success and self awareness. Students who complete the PASS program persist at a significantly higher rate than the general college population. Performance in PASS predicts future performance in introductory science and math courses. The project report provides an overview of the project; a section tracing the project from problem definition to project conclusion with a discussion of administrative pitfalls; information on the background and origins of the project organized into phases with a focus on organization, policies, and funding; a full description of the project; and an evaluation and project results. (DDR)

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# PROGRAM FOR ACCESS TO SCIENCE STUDY (PASS)

## COVER SHEET



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Summary

The Program for Access to Science Study (PASS) consists of a preparatory science course which is taught in tandem with a special counseling seminar. Problem solving is taught using content in chemistry and physics. The curriculum is divided into cycles, each built around a single topic. A problem set related to the topic and an illustrative lab experiment are introduced. The students perform the experiment, analyze the data obtained, work on a problem set based on the experiment, and take a quiz. The seminar is designed to promote students' ability to monitor, evaluate and adjust their behavior in order to achieve their academic and personal goals, and to address issues relevant to achieving academic and personal success and self awareness. Students who complete the PASS program persist at a significantly higher rate than the general college population. Performance in PASS predicts future performance in introductory science and math courses.

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## Executive Summary

A. Overview

The Program for Access to Science Study (PASS) is designed to help underprepared students pass their introductory science courses by teaching them essential problem solving skills in science and helping them achieve the degree of self awareness which will enable them to direct and control their academic lives.

The program blends counseling seminars with a preparatory science course to provide an environment in which students are guided and monitored in the development of new learning and thinking strategies, and behaviors which promote success in college.

B. Purpose

The project address the inability of many students to complete introductory science courses, which lessens the chance that they will successfully complete a science major. A primary cause of failure lies with the student's lack of instruction in problem-solving skills at the primary and secondary levels. It has been demonstrated that students provided with instruction in problem-solving skills exhibit greater academic achievement. In addition, students who fail to become integrated into the academic and social life of the college are more likely to drop out. When students understand what is expected of them in college and become effective in meeting these expectations, they identify as members of the college community and are more likely to persist until graduation.

PASS strives to address both reasons for failure by providing students interested in pursuing science-based careers with essential problem solving skills, while developing a different approach to life which allows them to attain their academic and personal goals.

C. Background and Origins

One of the project directors (M. Roth) supervised a minority assistance project for students in science and engineering within the

Department of Special Programs, (SEEK) for ten years prior to the start of the PASS project. Through this she gained extensive experience in defining the nature of the underprepared students, and their needs. For two years prior to the startup of PASS the co-project director (M. Weiner) joined her in this program, designing and teaching the introductory science course, which incorporated a problem solving approach into the curriculum.

In the summer of 1988 and 1989, the project directors supervised a program for incoming freshmen, in which some of the PASS curriculum was piloted. The four week project included demonstration lectures, laboratory experiments, peer problem solving and discussion sessions, the development of science study skills and a pertinent review of mathematics.

D. Project Description

The PASS semester includes a preparatory science course which is taught in tandem with a special counseling seminar. Along with formal classes, the students are required to attend weekly two hour group tutorial workshops. In the following semester the students are referred to the college's retention programs in science and engineering which provide tutorial workshops to supplement the regular introductory science courses, and counseling.

Problem solving in the science course is taught using content in chemistry and physics. The curriculum is divided into cycles, each built around a single topic. The first class is devoted to a general problem set related to the topic and a brief introduction to an illustrative lab experiment. In the second session, the students perform the experiment in the lab. In the third session they analyze the experimental data obtained and are introduced to a problem set based on the experiment. The fourth (and sometimes fifth) classes involve further discussion of the problem set, a review, and finally a quiz.

The seminar is designed to promote students' ability to monitor, evaluate and adjust their behavior in order to achieve their academic and personal goals and to address issues relevant to achieving academic and personal success and self awareness. Students' are encouraged to be actively involved in managing and controlling their academic experience and in assessing their own progress.

The semester begins with an introduction to the idea of paradigms which influence students' behavior, attitudes and feelings. The discussion which follows relates these ideas to the students' experience with the

science course, and aims to elicit those responses from the students which will enable them to take responsibility instead of blaming circumstances. The counseling agenda is incorporated directly into the curriculum of the science course. One hour a week (out of four hours) is devoted to this counseling seminar.

E. Results

(a) The retention rate of students who complete the PASS program is significantly higher than that of the general college population. Performance level in PASS is a strong predictor of future performance particularly in the introductory science and math courses, compared with a cohort of students registered in a parallel course.

This is based on a review of the transcripts of 130 PASS participants from Fall 1989, Fall 1990, Spring 1991, and Fall 1991, to see if they were still registered as of the Spring 1992 semester, and to record their grades in the introductory courses.

(b) Successful participants made positive changes in their attitudes and behaviors, as demonstrated by an increased ability to manage their personal lives, to understand the expectations of college life, and to be better problem solvers in PASS and in their personal lives.

Students who made positive behavior changes earned better grades in PASS, and in subsequent course work. Changes in attitudes and behaviors were measured by students' self reports and instructor evaluations. All measures showed significant correlations.

F. Summary and Conclusions

The results of our evaluation of PASS clearly show that those students who succeeded in the PASS coursework and made positive changes in their behaviors, remained in college and passed their first college level courses.

Student failure and college attrition pose a problem of great national importance, depriving the nation of large numbers of able college graduates who can contribute to the economic competitiveness and national security of the United States. The problem is most acute among those underrepresented minority students who enter college underprepared. By targeting underprepared students, and their reasons for failure, PASS has it greatest impact where the situation is most serious.

In dealing with high risk students where even small successes are noteworthy, the results described in this proposal are remarkable.

## Body of Report

PROJECT OVERVIEW

The Program for Access to Science Study (PASS) is designed to help underprepared college students interested in science - based majors pass their introductory science courses. It grew out of our experience with underprepared students, and attempts to identify and address the causes for their failure, such as a lack of problem-solving skills and insufficient understanding of the expectations of college. A preparatory program was deemed the appropriate response to the problem because it is imperative that instruction on essential problem-solving and college survival skills begin immediately.

The PASS project: 1. Targets students who are not yet eligible for the regular science curriculum.

2. Provides a a curriculum which integrates problem solving instruction with scientific content without the curricular constraints of a regular freshman science course.

3. Blends pedagogy with counseling in an attempt to deal with the several factors that contribute to student failure, including an ineffective approach toward their studies and to college life.

Our initial efforts included a four week summer program for incoming freshmen, which had a positive impact on their freshman year passing rates. However, we realized that for a program whose objective is to bring about lasting changes in student behaviors, a four-week intervention must be extended over a longer period to be truly effective.

The academic year PASS project was run for the first time during the Fall 1989 semester, with FIPSE support. The student participants were limited to entering freshmen who needed no more than one semester of remediation in reading and/or writing and no more than two semesters of remediation in mathematics. The counseling curriculum was taught in a special Freshman Orientation course. The PASS project was run for the second time in the Fall 1990 semester with FIPSE support, and the students were selected in the same manner. Beginning in Spring 1991, the PASS preparatory course was institutionalized and given the number

Chemistry 5.1. The counseling curriculum was incorporated directly into the Chemistry 5.1 schedule as a weekly seminar. Enrollment was open to all students, not only freshmen, who were programmed by their advisors to take a preparatory science course. Their skills profiles were largely the same as those in the original PASS groups.

The project evaluator was involved in all aspects of the evaluation from the beginning of the project, so that data on student performance and attitudes was gathered and analyzed on a continuous basis throughout the project. After the Spring 1992 semester, all the data gathered since 1989 was compiled and analyzed again to get a total picture of the accomplishments of PASS. The most pertinent results were incorporated into a proposal to the National Diffusion Network, as the cornerstone of an effort to disseminate the PASS concept and techniques. The following report is taken largely from that proposal.

PURPOSE

The project addresses a significant national problem: the inability of many students to complete introductory science courses. A cycle of failure may set in when students who are underprepared are confronted with first-year college material where requirements for study are often very different from their previous experience. Failure to succeed in their beginning courses lessens the chance that students will successfully complete a science major, and therefore unacceptably narrows their career choices. Research shows that a primary cause of failure often lies with the student's lack of instruction in problem-solving skills at the primary and secondary levels. It has been demonstrated that students provided with instruction in problem-solving skills will exhibit increased academic achievement. Success early on can provide the needed impetus to pursue and complete a college level science curriculum.

In addition, students who fail to become integrated into the academic and social life of the college are more likely to drop out. When students understand what is expected of them in college, when they learn how to manage their own lives so that they can meet the new academic demands, and when they develop networks of support within the college, they see themselves realistically as college students and are more likely to persist until graduation.

PASS strives to address both reasons for failure by providing students interested in pursuing science-based careers with essential problem-solving skills, while developing a different approach to life which enables them to attain their academic and personal goals.

BACKGROUND

The City College is the oldest of the 10 colleges of the City University of New York. It is a large urban college with an undergraduate enrollment of approximately 11,500 matriculated students. Of these, 42% are Black, 17% are white, 27% are Hispanic, 13% are Asian, and 1.2% are Native Americans. Only seven colleges in the nation enroll more students with Spanish surnames; only seven colleges enroll more Black students. The School of Engineering has the largest enrollment and graduates more minority students than any other school in the nation.

Our students, characterized as underprepared, have high aspirations of entering professional careers after college graduation. Having been successful in high school, they feel ready for college-level work. However, the emphasis on memorization of facts in high school instead of instruction which emphasizes problem solving has left the students unprepared for college level science and math. Furthermore, in high school their school work was completed in the classroom; therefore good study habits were not critical to academic success. The typical formula for college study which mandates two hours of homework for each class hour, raises questions for the student about time-management, study space and environment, family and work responsibilities, and self discipline. It is our observation that when confronted with requirements for study different from their previous experience, many students do not rise to the challenge but shrink from it and rely on already developed, inadequate approaches to study.

The results of such poor preparation is that 80% of the freshmen at CCNY require some form of remediation; 40% of the students fail or drop out in the first semester of general chemistry, 60% in general physics, and 45% in calculus.

A preparatory program which addresses both aspects of student failure is critically important for those students who are not yet eligible for college science. Blending counseling with a preparatory science course provides an environment in which students can be guided and monitored in the development of new learning and thinking strategies, and behaviors which promote success in college.

One of the project directors (Roth) supervised a minority assistance project for students in science and engineering within the Department of Special Programs (SEEK) for ten years prior to the start of the PASS project. Through this she gained extensive experience in defining the nature of the underprepared students and their needs. For two years prior to the startup of PASS, the co-project director (Weiner) joined her in this program, designing and teaching the introductory science course, which incorporated a problem-solving approach into the curriculum.

In the summer of 1988-89, the project directors supervised a program for incoming freshmen in which some of the PASS curriculum was piloted. The four-week project included demonstration lectures, laboratory experiments, peer problem-solving and discussion sessions, the development of science study skills, and a pertinent review of mathematics. Close consultation among the interdisciplinary faculty resulted in a well-integrated program.

PROJECT DESCRIPTION

A. Instructional Curriculum and Approach - The PASS semester includes a preparatory science course which is taught in tandem with a special counseling seminar. Along with formal classes, the students are required to attend weekly two-hour group tutorial workshops. In the following semester, the students are referred to the retention programs in science and engineering which provide tutorial workshops to supplement the regular introductory science courses, and counseling.

Problem solving in the science course is taught using content in chemistry and physics. The curriculum is divided into cycles, each built around a single topic. The first class is devoted to a general problem set related to the topic and a brief introduction to an illustrative lab experiment. In the second session, the students perform the experiment in the lab. In the third session, they analyze the experimental data obtained and are introduced to a problem set based on the experiment. The fourth (and sometimes fifth) classes involve further discussion of the problem set, a review, and finally a quiz.

The seminar is designed to promote the students' ability to monitor, evaluate and adjust their behaviors in order to achieve their academic and personal goals and to address issues relevant to achieving academic and personal success and self awareness. Students are encouraged to be actively

involved in managing and controlling their academic experience and in assessing their own progress.

The semester begins with an introduction to the concept of paradigms which influence students' behaviors, attitudes and feelings. The discussion which follows relates these ideas to their experiences with the science course, and aims to elicit responses from the students which will enable them to take responsibility instead of blaming circumstances. Students learn to differentiate between issues over which they have control (Circle of Influence) and those which are beyond their control (Circle of Concern), in order to help them achieve the goal of taking charge of their lives. The counseling agenda is incorporated directly into the curriculum of the science course. One hour out of four hours per week is devoted to this counseling seminar.

A writing component is integrated into the PASS syllabus. It is used solely to enhance learning in the sciences by forcing students to communicate their understanding of problem-solving strategies and scientific concepts.

B. Learner Activities - In the instructional components of the program, including the group tutorial workshops, the problem-solving approach takes place in an interactive participatory setting. Through well planned and ordered questions, the instructor or tutor helps the students to apply problem-solving strategies instead of merely helping them to arrive at answers. The goal of this teaching method is to place students in the role of active learners rather than passive observers.

C. Learning Materials - The emphasis of PASS is on problem-solving strategies, group relationships, and student behaviors. By not focusing on a specific curriculum, the program is adaptable to a variety of subject areas and academic settings. At City College, problem sets and experimental instructions for each cycle are distributed to the students. These are collected from other sources or made up by the program staff.

D. Staffing and Management - The PASS project is managed by the co-directors (Weiner/Roth). The staff includes one graduate student science instructor for each section of the preparatory science course, a graduate student in psychology to teach the seminars, a tutor coordinator, undergraduate peer tutors to lead the group workshops, and lab technicians to prepare the experiments and help the students in the lab.

The preparatory science course and counseling seminars are adjusted on an ongoing basis by the project staff working as a team. The science

instructors, seminar leaders, tutor coordinator, and project directors meet weekly to discuss the progress of the program and individual student participants. As a result of the feedback obtained from the different programmatic perspectives, we are able to modify the curriculum and our approaches, and deal with problems immediately. We also gain a total picture of each of our participants.

E. Staff Development - The regular discussion of our approach to teaching these materials, and the exchange of ideas, has influenced the teaching approach of our faculty. We place emphasis on making the student an active participant in each class and seminar session.

In the startup phase of the project, training sessions for new staff are held before the semester begins. Through the use of role playing, the individual faculty and tutors begin testing out the curricular materials and instructional strategies. Each instructor and tutor presents the solutions to problems to the other faculty who are role-playing as "students", using a technique of interactive questioning. The "class" provides suggestive questions to force the instructor to adjust his or her presentation.

A result of the PASS experience is the development of a cohort of junior faculty are who are trained to teach the large body of underprepared students entering our colleges today. (At City College, these junior faculty are graduate students.) The constant consultative process of input and feedback produces teachers who are sensitive to the needs of underprepared college students and are able to tune the content of the course to the level of their students, which may change from semester to semester.

F. Monitoring the Project - The team approach to the management of PASS facilitates continuous monitoring of all PASS activities. In addition, the project evaluation procedures, in place from the beginning of our operation, provide feedback from students and instructors each semester, so that the effectiveness of the various project components can be fine-tuned.

G. Students - Two groups of PASS participants were enrolled for the Fall 1989 and 1990 semesters. They were all entering freshmen, selected from the 80% of freshmen who need some form of remediation. The majority of the participants selected engineering as their major; others were science or nursing majors. Students were admitted to PASS if according to their scores on the CUNY Skills Assessment Test, they required one or two semesters of remediation in math (eg., intermediate algebra and trigonometry), and no more than one semester of remediation in reading and/or writing (many were eligible for the standard freshman English course).

Enrollment in PASS for Spring 1991, Fall 1991 and Spring 1992 was open to all students who were programmed by their academic advisors to take a preparatory course in science. These students' skills profiles were largely the same as those of the students in the previous PASS groups, but were not a prerequisite for joining the program. One hundred and sixty students completed the PASS course during the five semesters of operation.

Students targeted for PASS can now be any undergraduates not prepared for first-level college science studies. For instance, upperclass students wishing to transfer to a science-based field, would be appropriate for the program.

H. Costs - Recurring operating costs are estimated below for instruction, training and supplies, on the basis of one section per semester. When science faculty teach the section as part of their regular course load, the program operates at a considerably lower cost.

| | | |
|---|---|---|
| Personnel: | Science Instructor (Incl. Staff Meetings) | $3500 |
| | Seminar Instructor (Incl. Staff Meetings) | $1300 |
| | Tutors | $ 800 |
| | Fringe Benefits | $1100 |
| | Total Personnel | $6700 |
| Personnel Training: | | $ 500 |
| Consumable Supplies: | | $ 500 |
| Total | | $7700 |

For each additional section per semester the extra cost would be approximately $6000.

PROJECT RESULTS

A. Outcomes - Transcripts of 130 PASS participants from Fall 1989, Fall 1990, Spring 1991, and Fall 1991, were reviewed to determine if they were still registered as of the Spring 1992 semester, and to record their grades in the introductory courses. The data showed that: (I) students who completed the PASS program had a significantly higher retention rate than the general College population; and (II) the level of performance in PASS was a strong predictor of future performance, particularly in introductory science and math courses, compared with a cohort of students registered in a parallel course.

Students and staff completed evaluation questionnaires at various points in the PASS semester to measure changes in attitudes and behaviors. The data from these questionnaires showed that: (III) successful PASS

participants made positive changes in their attitudes and behaviors, as demonstrated by an increased ability to manage their personal lives, to understand the expectations of college life, and to be better problem solvers in PASS and in their personal lives.

B. Description of Evaluation Methodology

1. Design - Data on academic performance and persistence were collected during the PASS semester, at the conclusion of the semester, and at the conclusion of all semesters through Spring 1992. The data from Spring 1991, Fall 1991, and Spring 1992 were compared with data from comparable cohorts. Data on attitudinal and behavioral changes were collected during the PASS semester and at its conclusion.

Two basic experimental designs were used: (a ) Control Group Time Series Design and (b) Single Group Time Series Design;

a: The Control Group Time Series Design was applied to the Spring 1991, Fall 1991, and Spring 1992 cohorts. Students who were randomly enrolled in either Chemistry 5 (control group) or PASS received the same level of course content during the same semester, at the same institution, and as much as possible from the same instructors, except that the PASS students received the enriched program which included counseling, the integration of problem solving, and group tutoring workshops. The students in the PASS and comparable cohort groups were identified as underprepared according to City College criteria. Standard College procedures were used for identifying and placing students, and for determining pass/ fail rates and grade point averages (GPA's).

b: The Single Group Time Series Design was applied to all PASS cohorts. The same group of students was followed at the beginning and conclusion of the program as well as the semester following PASS (except the Spring 1992 cohort). The two varieties of this Time Series Design were implemented. In one, the PASS students were longitudinally followed through subsequent academic years (this was appropriate for the Spring 1991, Fall 1990, and Fall 1989 cohorts), in the semester subsequent to PASS (particularly the Fall 1991 cohort), and in pre/post comparisons at the beginning and conclusion of the PASS semester (particularly the Fall 1991 and Spring 1992 cohorts). In the other design, data were collected in cross-sectional studies of the same categories of students.

2. Sample - The students in the Fall 1989 and Fall 1990 cohorts were selected as described earlier. All had the option of taking the parallel Chemistry 5 course. It is assumed they chose between the two on the basis of class schedules since they were usually not informed about the differences between PASS and Chemistry 5 during registration.

The Spring 1991, Fall 1991, and Spring 1992 groups contained students at any class level who were not yet eligible for the introductory science and math courses. They were selected according to the same procedure used to assign students to Chemistry 5. The choice between PASS and Chemistry 5 was made as randomly as before.

All program participants were included in the sample used for evaluation. The number of students, listed by semester were:

| **PASS** | | **Comparable Cohort** | |
|---|---|---|---|
| Fall 1989 | 34 | | |
| Fall 1990 | 45 | | |
| Spring 1991 | 20 | Spring 1991 | 20 |
| Fall 1991 | 31 | Fall 1991 | 38 |
| Spring 1992 | 30 | Spring 1992 | 44 |

3. Instruments and Procedures - The instruments and procedures were developed by the program evaluator and the directors of PASS. The same instruments and procedures were used and administered at the same point in time during all semesters of data collection.

The following data were collected on retention and performance: (a) At the conclusion of the Spring 1991, Fall 1991, and Spring 1992 semesters, data were obtained on passing rates and grade distributions for the PASS and Chemistry 5 courses from transcripts and instructors' records. At the conclusion of the Fall 1989 and Fall 1990 semesters, the same data were obtained for the PASS course. (b) At the conclusion of the Spring 1992 semester, data for the 1991 PASS and Chemistry 5 cohorts were obtained from transcripts. The data included enrollment, grade distributions and passing rates in science and mathematics courses; GPAs; and retention of students in comparison with CCNY rates. (c) Data from the Fall 1989 and Fall 1990 cohorts of PASS students were obtained from transcripts as in b.

During the PASS preparatory semester, the following data were collected on students' attitudes and behaviors: (a) completion of the course with passing grades, from transcripts; (b) parallel evaluations of students by science and seminar instructors, and students' self evaluations at the

conclusion of the preparatory semester and (c) evaluations on the use of problem solving strategies which employed parallel evaluation forms, and were periodically assessed on course tests.

A problem-solving form was devised to aid the students and instructors in assessing the application of specific problem solving strategies. Students were asked to make a clear statement of the problem and the goal, to write down each step in the solution, to recall information needed for each step, and to connect the statement of each step with its mathematical solution.

4. Data Collection - The procedures and instruments were consistently implemented, under the close supervision of the program directors, as follows: (1) PASS students completed pre-program questionnaires on the first day of the course; (2) each test included applications of problem-solving strategies; (3) faculty, seminar instructors, and students completed the post-program evaluations at the conclusion of the course; and (4) grade transcripts for Chemistry 5 and PASS students were obtained at the end of each semester.

The raw questionnaire data (selected responses), raw test scores, and grades were entered into a computerized database for analyses by the program evaluator. The data on students' ability to apply problem solving strategies were collected from the problem solving forms which were administered during regular class exams. The instructors rated how well students stated the problem and the steps in the solution, the information needed for each step, and the connection between the steps and the mathematical solution. This rating became a part of the exam grade, and the information was used by the students and instructors in assessing their problem solving skills on the evaluation questionnaires.

5. Data Analyses - The data were subjected to several kinds of statistical analyses, depending on the conclusions to be drawn. (1) Descriptive statistics were calculated for all questionnaire responses, test grades, and grade information from the transcripts, which included N's, means, medians, standard deviations, and distributions (numbers and percents). (2) Relevant parallel evaluations by faculty, seminar instructors, and students were intercorrelated (within-evaluator ratings) and correlated (across-evaluator ratings) to determine the degree of agreement . In general, the range of intercorrelations indicated that ratings assigned by specific categories of individuals reflected a range rather than one general impression. Science

faculty, seminar instructor, and student ratings were correlated with other relevant ratings and grades, although identical patterns did not emerge for all possible relevant relationships for all cohorts. Spearman rank order correlations with .01 and .05 levels of significance were used to reject the null hypothesis of no relationship. (3) Where appropriate, a few inferential, nonparametric tests of significance were computed, since the samples could not be assumed to be normally distributed. (4) The few qualitative responses made by PASS students on their post-program questionnaires were recorded verbatim, and similar responses were categorized in order to summarize the comments.

C. Description of Results - Data is provided in this section on three major outcomes which demonstrate the effectiveness of PASS.

(I) Students who complete the PASS program have a significantly higher retention rate than the general College population.

**Table 1**
**Retention Rates**

| Cohort | PASS Students | General College Population |
|---|---|---|
| Fall 1989 | 85% entering freshmen retained after 5 semesters | 59% entering freshmen retained after 4 semesters |
| Fall 1990 | 83% entering freshmen retained after 3 semesters | 75% entering freshmen retained after 2 semesters |
| Spring 1991 | 95% retained after 2 semesters | See narrative below |
| Fall 1991 | 95% retained after 1 semester | |

These data reveal a significantly higher retention rate for the PASS participants compared with the general College population. The College has retention data for the Fall semester only. However their data does not vary from year to year. In a study of students entering in Fall 1986, 77% were retained after two semesters; 59% after four semesters; and 50% after six semesters. For students entering in Fall 1985, the data are 77%, 59%, and 48% retained after two, four, and six semesters, respectively. Therefore, data from Fall cohorts can be used for Spring cohorts as well.

(II) The level of performance in PASS is a strong predictor of future performance, particularly in the introductory science and math courses, in comparison with grades in Chemistry 5 for comparable cohorts, which were not well related to other course grades.

**Table 2**

**Grade Point Averages (End of Spring 1992 semester) Correlated with Grades in PASS and Chemistry 5 Grades.**

| Cohort | PASS Correlation | Chem 5 Correlation |
|---|---|---|
| Fall 1991 | .62 (P< .01) | .35 (P< .05 ) |
| Spring 1991 | .62 (P< .01) | No significant results |
| Fall 1990 | .47 (P< .01) | NA |
| Fall 1989 | .62 (P< .01) | NA |

**Table 3**

**Course Grades Correlated with PASS Grades**

| Cohort | Course | Correlation |
|---|---|---|
| Fall 1991 | Intermed. Algebra | .67 (N=15) |
| | Pre-Calculus | .70 (N=12) |
| | Trigonometry | .55 (N=10) |
| Spring 1991 | Intermed. Algebra | .81 (N=10) |
| | Pre-Calculus | .94 (N= 8) |
| Fall 1990 | Pre-Calculus | .61 (N=23) |
| | Trigonometry | .59 (N=24) |
| Fall 1989 | Intermed. Algebra | .62 (N=27) |
| | Pre-Calculus | .62 (N=29) |
| | General Chem I | .51 (N=28) |
| | General Chem II | .61 (N=11) |
| | General Chem Lab | .53 (N=10) |

All values significant at the .01 level

These data indicate that PASS performance is a predictor of future academic performance. Grades in the PASS course correlate moderately highly to highly with grade point averages and grades in math and chemistry. Grades in biology and calculus are not reported here because of small sample sizes, but they are reported in the next section on supplementary evidence.

The comparable cohort data for the Spring 1991 and Fall 1991 Chemistry 5 classes show significant relationships between Chemistry 5 grades and math grades only for the Fall 1991 group, and of these correlations, only the intermediate algebra grades had a higher correlation coefficient than those of the study sample (PASS).

(III) Successful PASS participants made positive changes in their attitudes and behaviors.

The study data indicate a relationship between PASS grades and changes in behavior. Since earlier data showed a significant relationship over time between grades in PASS and subsequent grade point averages (as well as grades in math and science coursework), this suggests that behavior changes influence future academic performance.

**Table 4**
**PASS Grades Correlated with Measures of Student Attitudes and Behaviors (Spring 1992 Cohort)**

| Measure | Correlation |
|---|---|
| Seminar instructors' evaluation of students' understanding of college expectations | .52 (P< .05) |
| Students' evaluation of their understanding of college expectations | .44 (P< .05) |
| Students' evaluation of significance of seminars | .46 (P< .05) |
| Students' evaluation of their changes in time management | .59 (P< .01) |

**Table 5**
**PASS Grades Correlated with Measures of Student Attitudes and Behaviors (Fall 1991 Cohort)**

| Measure | Correlation |
|---|---|
| Seminar instructors' evaluation of students' understanding of college expectations | .61 (P< .01) |
| Seminar instructors' evaluation of students' application of problem solving in course work | .73 (P< .01) |
| Seminar instructors' evaluation of students' time management | .83 (P< .01) |
| Students' perception that they learned to do better in their coursework | .66 (P< .01) |

It should be noted that the seminar instructors' evaluations are important here since the seminar format allowed the instructor to more intimately observe the behavior of the students.

**Table 6**
**Student Self Reports On Understanding the Expectations of College Correlated with Behavioral Changes (Spring 1992 Cohort)**

| Behavioral Change | Correlation |
|---|---|
| Change in preparations for tests | .60 (P< .01) |
| Change in time management | .44 (P< .05) |
| Change in negotiations with family | .50 (P< .05) |

The variable, change in negotiations with family, is of great importance for commuter students who are often the first in their families to attend college. As a result, these families may have little appreciation of the study

requirements for college students. This offers an explanation why a positive change in negotiations with family to improve studying at home correlates with positive changes in preparation for tests (.69, P<.01) and positive changes in personal problem solving (.52, P<.01)

D. Supplementary Results - The data in this section does not relate directly to the three major outcomes, but supports them tangentially and underscores the impact of PASS on student performance and behaviors.

**Table 7**
**Course Performance of All PASS Students Prior to Spring 1992 in Science and Math**

| Course | Number of students | % C or Better | %D or Better | CCNY Pass rate |
|---|---|---|---|---|
| Int. Algebra | 71 | 83 | 93 | 75 |
| Pre-Calc. (Incl. Trig) | 214 | 72 | 81 | 68 |
| Calculus I, II | 66 | 64 | 79 | 74 |
| Gen. Chem. I, II | 81 | 56 | 65 | 73 |
| Gen. Bio I, II | 28 | 75 | 93 | 86 |

The mean grade for PASS students in all science courses was 2.13 as of Spring 1992, and was 2.04 in the calculus courses. The data show that PASS participants do well in their introductory science and math courses, compared with the general college population. Considering that these students were initially considered underprepared (or high risk), this represents a substantial achievement.

**Table 8**
**Spring 1992 Student Perceptions of the Impact of PASS (mean score on a scale of 1-4)**

| | |
|---|---|
| I learned skills to do better coursework | 3.6 |
| PASS helped me to improve my grades | 3.3 |
| I learned problem solving skills | 3.3 |
| I learned what to expect in college | 3.1 |
| I gained valuable experience in science | 3.6 |

**Table 9**
**Fall 1991 Student Perceptions of the Impact of PASS (mean score on a scale of 1-4)**

| | |
|---|---|
| I learned skills which improved my coursework | 3.3 |
| PASS helped me to improve my grades | 3.0 |
| I learned problem solving skills | 3.3 |
| I learned what to expect in college | 3.3 |
| I gained valuable experience in science | 3.3 |

The data in Tables 8 and 9 indicate that students attributed positive changes in their behaviors and attitudes to their experience in PASS. These variables describing the behavioral changes they attributed to their PASS experience correlate positively with students' grades in PASS (Tables 4 and 5). Since performance in PASS is a predictor of future academic performance, this suggests that there is a relationship between changes in behavior and attitudes resulting from the PASS experience, and future academic performance.

**Table 10**
**PASS Students' Application of Problem Solving Strategies-Spring 1992 Cohort (mean score on a scale of 1-4)**

| | |
|---|---|
| Problem Solving Strategies as Evaluated by Faculty | |
| Understands what problems asked | 3.1 |
| Recalls information | 3.0 |
| Breaks problem into components | 3.1 |
| Executes solution | 3.1 |
| Problem Solving Strategies (Student Self Evaluation) | |
| Understands what problems asked | 2.8 |
| Recalls information | 2.8 |
| Breaks problem into components | 2.7 |
| Executes solution | 3.0 |

In addition, students self-reported that they learned to apply problem-solving techniques (mean rating of 3.3), and applied these problem-solving techniques in other coursework (mean rating of 2.9).

**Table 11**
**PASS Students' Application of Problem Solving Strategies-Fall 1991 Cohort (mean score on a scale of 1-4)**

| | |
|---|---|
| Problem Solving Strategies as Evaluated by Faculty | |
| Understands what problems asked | 2.6 |
| Recalls information | 2.6 |
| Breaks problem into components | 2.5 |
| Executes solution | 2.6 |
| Problem Solving Strategies (Student Self Evaluation) | |
| Understands what problems asked | 2.7 |
| Recalls information | 2.6 |
| Breaks problem into components | 2.3 |
| Executes solution | 2.6 |

In addition students self-reported that they learned to apply problem solving techniques (mean rating of 3.3).

The perceptions of the Spring 1992 cohort that they changed their approach to study by acquiring and applying problem-solving skills in PASS and in other coursework, correlated with the perceptions that PASS helped them learn what to expect in college and thus do better in coursework. Those who learned what to expect in college also felt they made the specific behavioral changes indicated in Table 6.

These data explain the relationship between attaining problem-solving skills and academic success, supporting the research which links the two. Our students felt that applying problem-solving skills to other coursework had an impact on their development as college students, and believed they had made positive behavioral changes which contribute to academic success as well. Furthermore, the Fall 1991 students' evaluation of their ability to apply specific problem solving strategies was supported by faculty evaluations of those skills.

E. Continuation of PASS

The PASS course is now part of the regular college curriculum, with two sections scheduled each semester. External funding for the seminar instructor and the peer tutors is still necessary, but funds should be available for the foreseeable future.

F. Dissemination Plans

Since the conclusion of our FIPSE grant, our major effort with regard to PASS has been the preparation of the proposal to include PASS in the National Diffusion Network. The results presented in this report have been incorporated into the proposal

SUMMARY AND CONCLUSIONS

1. PASS students were identified as high risk, yet our results show that PASS students have a higher retention rate than the general college population. This invalidates the possibility that PASS students who were selected had greater potential than the average City College student, when the opposite is true.

2. During the Spring and Fall semesters of 1991, students in need of an introductory science course were randomly assigned to the PASS program or to the standard Chemistry 5 classes, so that the two groups were initially comparable in terms of potential, maturity, motivation, etc. However our results indicate that only PASS students' performance is a strong predictor of future academic performance, particularly in terms of overall grade point averages. Therefore, although both groups entered the introductory courses with the same background, only the PASS group acquired the skills that can be better transferred to other courses. This is a deliberate result of PASS, which has a primary goal, to develop skills which can be applied to future studies. PASS encourages students to assess themselves and their progress realistically, and most importantly to accept the challenge of future academic work, instead of shrinking from it. It emphasizes an interactive atmosphere which produces active learners. It emphasizes the development of support networks among the students which promotes their integration into college life. It encourages students to take control of their academic lives and trains them to be effective students. Courses such as Chemistry 5 may be effective in teaching the science material , but they do not deal overtly with the teaching of transferable skills which lead to success in future courses.

3. Those students who were successful in PASS developed the positive behaviors and attitudes that lead to success in the future. The students perceived that the specific skills they gained from PASS made a positive impact on their lives; that PASS taught them what to expect of college, and how to apply problem solving beyond the PASS experience. Moreover, academically successful PASS students reported that PASS changed the way they managed time and dealt with their families. Because of the background of PASS students, and the process used to select them, there is no reasonable alternative explanation that the target group initially possessed some extra degree of maturity which would have caused these positive behavioral changes without the intervention of PASS.

Thus the results clearly show that those students who succeeded in the PASS coursework and made positive changes in their behaviors remained in college and passed their first college level courses.

Student failure and college attrition pose a problem of great national importance, depriving the nation of large numbers of able college graduates who can contribute to the economic competitiveness and national security of the United States. The problem is most acute among those underrepresented minority students who enter college underprepared. By dealing specifically with these underprepared students, and directly with their reasons for failure, PASS has its greatest impact where the situation is most serious.

In dealing with high risk students where even small successes are noteworthy, the results described in this report are remarkable.

# APPENDIX

It is our perception that programs dealing with preparatory and supplementary instruction in science are taking a back seat (way back) to programs for systemic change in college curricula. This perception was reinforced at a recent AAHE meeting in which we and three other FIPSE grantees served on a panel on issues in science education. While reform of college science curricula is of course very desirable it does not deal with the basic problem of underprepared students. Our experience with our FIPSE project students, and the data from our evaluation, show that our students' high school backgrounds often suffer from a lack of rigor and insufficient attention paid to mastery of more quantitative and problem-solving aspects of science. The students are not challenged to achieve at the highest levels. The result is a lack of problem solving skills, poor study habits and unrealistic expectations. Since they passed their high school courses, these students are fooled into thinking that they are ready for college level science work.

Thus while new approaches to the regular college science curriculum will make science more comprehensible to students, the underprepared students will inevitably be confronted by their deficiencies, most noticeably a lack of problem solving skills. They will fall behind others, beginning the cycle of failure that we described in our report.

We are concerned that while there are many FIPSE projects on course reform and new course materials, insufficient attention is being paid by FIPSE to programs which prepare students for these courses, perhaps under the vain hope that better teaching, a better approach to science, or better material, will somehow elevate the underprepared to a competitive position.

Systemic change at the pre-college level could put us out of business, but this type of change is not likely in the foreseeable future given the cumbersome nature of large school districts and their resistance to change. Therefore we believe that preparatory courses, particularly in the sciences, will be a crucial aspect of college curricula for a considerable time to come. We urge the FIPSE staff to reconsider their stand and put innovative proposals in this area on the front burner.

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